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Complexity and Planning in the 21st Century: Intelligence Requirements to Unlock the Mystery

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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15. Abstract:
The strategy of battlespace dominance envisioned in Joint Vision 2010 demands that intelligence focus on support to decision-making by providing analytic estimates to reach planning decisions, and analyze opponent's reactions to those decisions. Planning for military operations in the environment envisioned in JV 2010 and Network Centric Warfare is inherently more complex than solutions that may be derived from the current joint intelligence planning doctrine based on a linear model. Understanding intelligence data and correlating it to enemy intentions in the age of asymmetric threats demands a new approach to analysis. Discovering all of the relevant data in today's ever expanding intelligence architecture and then examining the linkages between the intelligence and possible outcomes is approaching near impossibility. This problem requires new methods and tools of analysis in order to avoid what has been described as the "curse of intended outcomes". Data visualization tools may aid a shift in analytic techniques from the probable to the possible. By examining possible outcomes, courses of action, and developing intelligence requirements to further understand them intelligence will provide the insight necessary to avoid locking in operations which lock out success.

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Thesis

"Intelligence operations contribute to the decision-making process in two stages. First they supply the leader with the information and analytical estimates support necessary for him to reach a decision. Then they follow up the success or failure of the decision and analyse the opponent's reaction."

-Michael I. Handel[1]

The perspective that Dr. Handel describes is not unique to a particular time-frame, it is an age old requirement which will not change in the foreseeable future.[2] In fact, the strategy of battlespace dominance envisioned in Joint Vision 2010 demands that intelligence remain focused on these basic requirements or risk catastrophic failure. Although the ability to "plug in" and communicate in the future may grow easier, the challenges to intelligence support for decision making will only grow more complex. The imperative for change was clearly delineated by former Chief of Staff of the Army, General Reimer, "First, the geo-strategic environment is becoming more complex and dynamic [as a result of ethnic rivalries, national tensions, terrorism]. . . . Second, advances in precision weaponry and the proliferation of weapons of mass destruction will make the future battlefield a more lethal place."[3] The growing complexity and lethality of the future battlefield will force a fundamental change in the way intelligence requirements are developed to support the planning process. This paper will examine the limitations of the current doctrine for intelligence support to the joint force commander's (JFC) decision making process in a technology enabled environment. This paper will focus on a conceptual model for development of intelligence requirements.

Introduction

History is replete with examples of military commanders acting as their own intelligence analysts, trusting no one and taking counsel from few. Napoleon was noted for his ability to visualize the battlefield and to operate independently in the realm of intelligence analysis. Baron de Jomini, a student of Napoleon's system, summarized his approach to intelligence as follows: "A general should neglect no means of gaining information of the enemy's movements, and, for this purpose, should make use of reconnaissances, spies, bodies of light troops commanded by capable officers, signals, and questioning deserters and prisoners."[4] Two points can be gleaned from this perspective; first, the general himself directs and analyzes much of the data gathered. Analysis was typically aided by the general's understanding of historical events, doctrinal employment of assets, and, finally, his understanding of the battlefield situation and his intended objectives. Second, planning is critical to the proper selection of surveillance and reconnaissance assets, and that selection ultimately influenced the type and character of information gathered. This approach was effective because battles did not typically move at the rate today's military does, therefore, the commander could depend upon sufficient time to complete the analysis and design strategies to properly carry out military operations.

Over time the ability of the commander to routinely study the histories and examine details of the battlefield on their own was challenged by advances in the speed of forces, the size of armies, and the increased lethality of weapons. As a result, operational commanders have come to rely upon others, namely intelligence analysts, to prepare information for situational awareness of the battlefield to aid in his decision making. This process has been

codified in today's planning guidance in the form of Joint Doctrine Publications. Both Joint Pub 2-0, Joint Doctrine for Intelligence Support to Operations, and Joint Pub 5-0, Doctrine for Planning Joint Operations, describe the planning process and its attendant analytic requirements. The intelligence officer and support staff for today's Joint Force Commander (JFC) are identified as the resident expertise for intelligence operations and enemy analysis by this doctrine.[5] This expertise ultimately drives not only operational considerations, but also the intelligence requirements development and the organization to respond to the requirements.[6] This doctrinal task may become untenable due to the complexity of the future envisioned in Joint Vision 2010 without change to the intelligence support process.

The Growing Complexity

Joint Vision 2010 (JV 2010) predicts a future far more complex than today's environment both in terms of threats and mission requirements.[7] In order to meet these challenges, JV 2010 calls for a fundamental shift from attrition warfare in a platform-centric strategy to a knowledge based force operating in a networked environment. Friendly forces are intended to conduct operations, lethal or non-lethal, from a position of "information superiority".[8] The attainment of information superiority is an inherently non-linear process, it is the result of a complex range of analysis reliant upon techniques which are neither deductive nor inductive, they may be something altogether different.[9] The key to success in this environment is the ability of U.S. forces to "lock in" success while "locking out" the adversary by eliminating their ability to conduct operations. "Lock-in" is a result of superior battlespace awareness which allows U.S. forces to block an adversaries options before they can be exercised, or before the opponent even recognizes the option.[10] In pursuit of this goal, intelligence is expected to provide the, ". . . insights concerning exploitable opportunities to

defeat the adversary and helps JFC's clearly define the desired end state . . ."[11], the presumed "information dominance" necessary for successful battlespace dominance.

The how of JV 2010 is emerging through conceptual models such as Network Centric Warfare (NCW). NCW is an operational concept designed to achieve information superiority, acting as a model for ". . . increased combat power by networking sensors, decision makers, and shooters to achieve shared awareness . . .."[12] The strategic template of JV 2010, and the operational concepts advanced in NCW, depict an environment rich in intelligence and optimized for precision engagement of threats described as asymmetric.[13] Both JV 2010 and NCW tend to address the implications for networked strategy from the perspective of knowing who the enemy is and where the battlefield lies, hence, the emphasis on concepts such as a sensor-to-shooter and dominant battlespace awareness. However, the gap between planning and engagement is not fully addressed in terms of threat recognition and the JFC's intelligence requirements to meet the decision cycle. The traditional model for intelligence support to planning has been cast in terms of linear analysis of doctrine, capabilities, and current intelligence, from this are derived courses of action and intelligence requirements to focus the intelligence efforts.[14] The JFC's intelligence requirements are combined with other factors, such as maturity of theater of operations, to determine the intelligence support architecture requirements. Ultimately, these factors combine to determine the intelligence flow to the JFC. Therefore, it is imperative that the problem be properly analyzed and requirements levied lest the JFC become a victim of his own analytic process.

Two key factors are likely to influence planning in the environment of NCW. First, the JFC's decision cycle time is likely to be compressed, perhaps to hours from days.

Second, the level of decision making complexity is certain to be increased by the range of options available to the aggressor.[15] The first issue is easiest to understand in view of the impact of technology on decision making. NCW is expected to be the fulmination of a technology enabled decision making process supported by a fully networked sensor grid and information backplane. This environment may well leave the JFC little time or capacity to review, collate and analyze the myriad of disparate data sources available. In this environment, the J2 and intelligence staff must be fully attuned to the JFC's objectives and have a complete grasp of the threat, the second problem of NCW.[16] Taken to its most critical ends, the operational environment envisioned in JV 2010 and NCW may drive the JFC to a less than optimal solution based on an imperfect understanding of options if the linear analysis process continues. In other words, relying solely upon the current doctrinal approach to intelligence support, in the complex environment of JV 2010, may lock out a commander's options and lock in vulnerabilities to an asymmetric threat.

Intelligence Information Flow to the Commander

Since World War II the intelligence community has adjusted to a series of major geo-strategic shifts and several significant technological advances which have each driven changes in customer requirements and the means to fulfill them.[17] In general, modern intelligence support development following Pearl Harbor is best characterized as centralized, demand-driven exploitation and production. In most basic terms, the commander demands answers and somehow the system finds them (within production limitations). It is up to the commander to use the information or reject it as he sees fit.[18] This process led to the rise of large organizations delivering intelligence ala carte by taking advantage of the smorgasbord of Department of Defense assets, and agencies within the federal government.[19] However,

over the course of the last ten years as the Soviet Union fell and military budgets shrank, the intelligence community was forced to consolidate and streamline. Ultimately, commanders have become reliant on a joint intelligence architecture with a less intimate relationship to the individual commander's personal needs.[20] This is in an important point to keep in mind as organizations are created to support JFC's.[21] Therefore, the focus on dominant maneuver enabled by information superiority places renewed importance on the establishment of intelligence requirements to support the JFC.

Intelligence derived from the demand driven production cycle has historically been delivered by the "push" architecture where predefined sets of information priorities were responsible for tailoring information flow to the commander. This process drove a broadcast of information from the producer to the user and was typically seen as a fixed production process. Requirements not previously defined are viewed as unscheduled production (results of introduction of uncertainty into the linear model) and force the system into spasmodic reactions to these emerging requirements. The results of this process vary depending upon the specific requirement levied (a known threat in a mature collection process- Russia vs. an emerging threat in an immature (or non-existent) collection process - East Timor).[22] Intelligence derived from this process was bundled and delivered to users in a "push" architecture either through message traffic or hardcopy delivery.

Fundamental changes in intelligence information systems during the late 1980's and throughout the '90's, paralleling the development of the INTERNET with advances in networking and database access, have begun to improve flexibility and access to intelligence. Although still a requirements based process, the improved user access to information has allowed analysts to derive unintended advantages through shared production and application

of information in ways not previously envisioned.[23] The intelligence community first began to incorporate networked computing technology with development of the Atlantic Deployable Intelligence Support System (LANTDISS) which ultimately became the Joint Deployable Intelligence Support System (JDISS). JDISS is a system which allows a user to access multiple intelligence databases, message traffic, send email, and conduct online analysis. The system was limited in its early stages by proprietary software and unique communications paths for each database and organization accessed, but the system proved its value during Desert Shield/Storm.[24] These hurdles have largely been overcome in the last five years through deployment of the Secret Internet Protocol Router (SIPRNET) and Joint Worldwide Intelligence Communication System (JWICS) supporting Secret and SCI level communications respectively, and incorporation of common web-based software and utilities. Success in this area is easily measured by the widespread incorporation of these processes into today's military planning and support environment.[25]

The evolution of intelligence tools and techniques has given JFC's, their staffs and intelligence support personnel, continuous access to the vast library of intelligence resources and analysts. This "pull" architecture has allowed intelligence analysts to dynamically update intelligence in real-time to clarify the commander's view of the battlespace and conduct research to support the commander's requirements. Building on this approach a significant effort has been put into development of the Joint Intelligence Virtual Architecture (JIVA). Tantamount to the system of systems envisioned to enable analysts to begin creating battlespace dominance through federated production. JIVA does not represent a single system or database, "The program aims to link intelligence users with their data rapidly and efficiently over a vast network."[26] The current incarnation of the systems approach to

intelligence support for JFC's is embodied in programs like the Global Command and Control System (GCCS) and Information Technology for the 21st Century (IT-21). Significant gaps in information at the operational level are beginning to be reduced with the increased availability of intelligence.[27] However, this process is still based on the notion of an intelligence professional mining data from available on-line resources.

Using a simple desktop PC with access to SIPRNET or JWICS, today's user has near complete visibility of the entire library of information collected on a daily basis, some analyzed some not. In addition, intelligence is also given a "smart push" to the user through a variety of means, including record message traffic and email, which may only serve to further complicate the information picture. During normal peace time operations this intelligence environment can be overwhelming, and during crisis it becomes nearly unmanageable. With the range of available information approaching the point of saturation, the ability of any user to wade through, absorb the relevant data, and find the critical linkages may become impossible. The concept of information superiority and battlespace dominance envisioned in JV 2010, may become unattainable goals as intelligence locks itself into the information at hand and locks out options not postulated or readily apparent because of the linear approach inherent in data mining.

As optimistic as the projections of NCW are, that "Forces harnessing the capabilities potentially available from this system of systems will gain dominant battlespace awareness, an interactive 'picture' which will yield much more accurate assessments of friendly and enemy operations within the area of interest,"[28] it is not unrealistic to postulate that those forces may only be seeing what they want to see, as a result of unrealized intelligence gaps. This point may be made painfully more complex if the Chief of Staff of the Air Force is

right, and ". . . the emerging reality that in the 21st Century it will be possible to find, fix or track and target anything that moves on the surface of the earth."[29] To confront these challenges we must design new ways to decide who and what is relevant for targeting, and when. Most likely this type of analysis will not derive from a linear process, but instead it will be found in the "white spaces" between what is known, what is unknown, and what is believed.[30]

Intelligence at the Speed of Command: The Truth is Out There

The intelligence process as embodied in today's doctrine is not incapable of success in the networked environment. The successes of Desert Shield and Desert Storm, as well as those enjoyed in Bosnia and Kosovo, have demonstrated that the intelligence process, and its attendant information support system, can still deliver targeting and analysis in response to the JFC's requirements in a conventional crisis.[31] However, the inherently non-linear analysis required to support the "lock out" of asymmetric threats will not grow from the demand driven linear intelligence process of today's doctrine. This challenge begs new techniques to support the JFC as he forms his plans for battle, and data visualization may be a means to begin attacking the problem.

Data visualization is difficult to capture in a single description or program today, however, as a concept, it challenges the basic structure of the intelligence cycle. A process built around data visualization would allow users to examine the full spectrum of information available for a contingency. The user could examine the interrelationship between the bits of intelligence, pairing them automatically or manually, in a fashion inconceivable to a linear process.[32] For this reason, the process of intelligence requirement development as, described today, may have no place in the future, instead, it may be replaced by what one researcher

has called a "quantum imaginative leap"[33]. This postulate has implications for not merely the way we organize and collect intelligence, but also how the commander arrives at decisions about force application.

Today, the PIR is derived from an intelligence gap in the commander's decision matrix, typically identified during the Commander's Estimate of the Situation (CES). As part of the CES, staffs work through all of the capabilities and options of both own force and opposing forces. Staff estimates examine Courses of Action (COA), developing key decision points for the commander, and ultimately scope the battlespace in terms of forces, mission objectives, and information shortfalls.[34] In other words, this process seeks to identify the probable. However, the growing potential of asymmetric threats, both in terms of the types and the origins of threats, increases the complexity of the operational environment making it ever more difficult to predict what is probable. Instead, the process forces a realignment of decision making to what is possible. A shift from the probable to the possible seemingly calls for a shift from an outcomes based decision matrix to an interactive decision template – the Commander's Decision Template.

In this process, the JFC becomes linked to the data pertinent to the mission at hand. This data would form a picture much greater than the mere amalgamation of discreet data bits as collected and catalogued by today's intelligence system. Instead, the template would display the data available categorized by that which is familiar to the user (previously accessed) and unfamiliar (not previously viewed) combined with key decision issues (location, forces available, doctrine, terrain, etc.) and it would display linkages between the various bits of data. From this a model of the so-called "white spaces" could be derived depicting the areas of uncertainty requiring a decision from the commander as to the

significance of the issue (significant enough to retain, or insignificant dismiss). If retained, additional answers may be sought to fill the gap. Those answers may either come in the form of a reanalysis of linkages or through pulsing the intelligence process. The net result of this process is to arrive at a decision on a course of action based on its possibility, not merely its probability.

Several past attempts at data visualization have fallen prey to budgets, technology and complexity. One example is the Army's PATHFINDER program. An early competitor in the data visualization process, the PATHFINDER concept was widely hailed, but as a standalone system it fell short due to complexity.[35] However, as with so many DoD programs, this application has not disappeared. Instead it has undergone evolutionary changes and become one of the applications within the JIVA scheme, albeit with a caveat identifying it as an intensely complex technology.

In order to develop the commander's decision template, it will be necessary to profile the decisionmaker in much the same way as marketing firms do for the purposes of selective marketing. The point here is to allow the "system" to begin a normative process for data display and adaptation of the linkage technique within the visualization process. The Commander's Decision Profile, would become a historical perspective of typical decision making processes used by the individual. This profile would take into account information viewed in the past, weights previously assigned to "white spaces" reviewed, types of information used, the order in which data is accessed, and other characteristics that may be gleaned from the process of data review and decision making. The point being to streamline the process of information collection, display and analysis in order to arrive at "white spaces"

identification and decisions more rapidly. This may be thought of as linking JFC's (consumers) to information (purchases) and decisions (products) to JFC's (consumers).

There are many marketing technologies under development intended to directly link consumers to their purchases and products to customers, the "Presto" network is one example.[36] "Presto" technology is a web based consumer device designed to identify and authenticate users and personalize their shopping by presenting items based on defined preferences, habits and needs. In addition, it would link a product to a requirement, such as an empty coffee cup to your desired fresh brew. Similarly, a commander may be directly tied to intelligence in a "smart" environment where the system recognizes the user, provides the latest intelligence and offers options for further tailoring data, the Commander's Decision Profile. Each time the user accesses the system they are delivered updated intelligence without wading through all of the available data to find the latest changes.

When the decision profile is combined with the decision template, issues may begin to arise in fashions not readily apparent in the current process of intelligence requirements development, due to the aforementioned limits of probability. In this environment, the "system" aides the user in recognizing requirements, allowing for near instantaneous pulsing of the network for the information. The process is much more than a simple search engine or data mining technique, it is a data visualization process designed to display information and its limitations. This conceptual approach only applies to the commander's decision process, it is not intended to supplant or compete with a sensor-to-shooter engagement. This process is intended to focus strictly on the commander's battlespace awareness in order to heighten the clarity of the decision making environment. By improving the clarity of awareness the

process of tailoring intelligence flow will shift from the probable to the possible fueling the process of battlespace dominance through information superiority.

Gathering the Truth

Even with a shift from developing requirements along the lines of what is probable to what is possible, the impact of intelligence will be limited by two key factors: the collections, and the control of information flow. The most significant change to occur in the realm of collections could be the sensor grid. Today's sensor grid is designed to provide discreet data bits which are cataloged, verified and analyzed. In the era of information superiority sensors will have to become sensitive to capabilities and intentions critical to customer's objectives, not simply data bits. As General King, the Director of NIMA, put it, "A key tenet of collaborative exploitation is that management is collaborative . . .."[37] It is important to note that in the rush to "lock in" success and "lock out" enemy options, U.S. forces will not always employ lethal technologies, therefore, a sensor grid attuned to providing targeting data alone will provide limited value.

For precision engagement to succeed the right targets must be hit, and that will depend heavily upon understanding the enemy. Rather than deploying a collection plan based on the "Kirby vacuum" approach of technical intelligence(collect everything possible and sort-out the important stuff later), JV 2010 and NCW depend even more heavily on the success of a sensor grid capable of providing intelligence about capabilities, doctrine, and strategy.[38] Typically a detailed understanding of enemies has only been derived through the addition of HUMINT to other assets.[39]

The limitations of any sensor grid deployed will only be compounded by the state of analysis within the intelligence community. Since the late 1980's, the intelligence

community has undergone significant downsizing and reorganization, as well as reprioritization.[40] There is also a growing disparity in the workforce between the older analysts trained by the years of the Cold War and the newly hired analysts who have had little opportunity to prove their trade.[41] Despite the best efforts to collect information, it may go unanalyzed because of priorities or a simple lack of analysts to examine the never ending flow of data.

Finally, the shift from developing requirements based on the probable to the possible will further complicate the information flow process. Just as the asymmetric threat adds to the range of possible, so to does it add to the range of analysis requirements. Therefore, as the JFC and the intelligence staff work through the Commander's Decision Template, the final step in the process will become an evaluation of the risk presented by the process. This may sound very familiar to today's doctrine for course of action development -- and it may be similar -- however, it differs in the manner of incorporation. In the proposed process the option is not eliminated from consideration, it falls further down in the decision making priority, but remains an intelligence requirement within the range of the possible. The logic behind this is illustrated by Michael Handel, "There is no rational connection between the degree of risk on the one hand and the choice of strategy on the other."[42]

Conclusions

The military environment envisioned for the 21st century will require innovation of the current intelligence support doctrine. The threat of asymmetric military operations places a new and significant analytic problem before the intelligence community. This threat challenges the fundamental approach to intelligence analysis as currently engendered in Joint doctrine. In order to support the technology enabled future, intelligence analysts can no

longer hope to support operational planning based on linear analysis. Instead, the intelligence community must strive to devise a system to support the commander's decision template through an intelligence analysis process searching for the possible, not merely the probable.

There are a variety of means to achieve this result, but the bottomline is that the "system" to support JV 2010 and NCW is non-linear and requires a level of complexity not resident in the analysis systems available today. The model suggested in this paper is centered around data visualization techniques designed to demonstrate the complexity of available information, the limitations of the intelligence, and, finally, focus the commander and his intelligence organization towards the "white spaces" for further analysis.

A shift from mere demand driven displays to smart systems which self-synchronize to support the commander's decision template will be the enabling technology for decision makers in the 21st century. The stresses of combat and the fog of war have proven to be the incubators of innovation throughout history, and as such it is clear that the demands of today's operational environment are already driving commanders to focus their efforts and their staffs to networked solutions. Joint experimentation has focused on command and control in the networked environment, and while the results have been mixed it is clear the system is delivering capabilities which enhance combat effectiveness.[43] The intelligence community is working hard to support the commander in this environment, however, to fully support the commander will require a fundamental shift in the way intelligence approaches its mission requirements. As a result, one of the early casualties may be the current doctrine for intelligence requirements development, as intelligence seeks to deliver a quantum leap in understanding. Recent military operations, such as those in Kosovo, continue to show the

need for new techniques and technologies. Each crisis has delivered yet another innovation, from streaming UAV video to the desktop, to information systems which support multi-national operations, as technology has continued to evolve and doctrine along with it.

Notes

[1] Michael I. Handel, ed., Leaders and Intelligence (London, England: Frank Cass & Co. Ltd., 1989), 9.

[2] The literature consulted for this paper which deals with the issue of intelligence support in the future is nearly unanimous on this issue, although it does not all agree upon the means for providing support. The following sources were key to forming this observation: Handel, Leaders and Intelligence.; Michael I. Handel, War, Strategy and Intelligence (London, England: Frank Cass & Co. Ltd., 1989).; David M. Keithley, "Leading Intelligence In the 21st Century: Past as Prologue," Defense Intelligence Journal, vol. 7, no.1, Spring 1998, 78-88.; Thomas R. Wilson, "Defense Intelligence Community Challenges for the 21st Century," Defense Intelligence Journal, Vol. 8., no.2, 1999, 7-10.

[3] Dennis J. Reimer, "The Army After Next: Revolutionary Transformation," Strategic Review, Spring 1999, 41.

[4] Handel, Leaders and Intelligence, 40.

[5] Joint Chiefs of Staff, Joint Doctrine for Intelligence Support to Operations, (Joint Pub 2-0) (Washington, D.C.: May 05, 1995), Chapter IV.

[6] Ibid., Chapter III.

[7] Chairman of the Joint Chiefs of Staff, Joint Vision 2010 (Washington, D.C., Joint Staff, 1996), 8. The anticipated future challenges are further delineated in several other sources used for this paper: Michael V. Hayden, "Warfighters and Intelligence: One Team – One Fight," Defense Intelligence Journal, Vol. 4, No. 2, Fall 1995, 18.; Keithley, 82. ; Reimer, 41-42.

[8] Chairman of the Joint Chiefs of Staff, 20-29.

[9] Planning for military operations in a world filled with asymmetric threats and supported by the sensor grid envisioned in JV 2010 and NCW is inherently more complex than solutions that may be provided by either deductive or inductive logic, it is a non-linear world. A range of possible models might include: The Chaos Theory as postulated by Edward Lorenz; "The Lorenzo Attractor," <http://library.thinkquest.org/3120/text/lorenz.htm> (January 29,2000) and further detailed at <http://library.thinkquest.org/3120/text/c-his1.htm fractal geometry > (January 29, 2000); Complexity Theory, Gerry Gingrich, "The Agile Mind of Leadership," Defense Intelligence Journal, Vol. 7, No. 1, Spring 1998, 67-77.; Abductive Logic, P. H. Liotta, "Strategy and the Curse of Intended Outcomes," Strategic Review, Winter 2000, 47-54. Each of these models and its authors presents a range of conclusions, but all seem to suggest one thing, that a complex world is not defined merely in terms of the obvious or known. Within this web of interconnected issues the realm of possibilities may be unimaginable and the outcomes unintended, often caused or influenced by the actions we undertake.

[10] Arthur K. Cebrowski, and John J. Gartska, "Network-Centric Warfare – Its Origin and Future," U.S. Naval Institute Proceedings, January 1998, Vol. 124, No.1/139, 31-33.

[11] Joint Chiefs of Staff, (Joint Pub 2-0), III-1.

[12] David S. Alberts and others, Network Centric Warfare: Developing and Leveraging Information Superiority, 2nd ed. (CCRP Publication Series, August 1999), 2.

[13] The American Heritage Dictionary of the English Language, defines Asymmetry as "a lack of symmetry or balance." In military terms, this implies a threat or military act which is directed against a narrow element of a

force intending to destabilize the force through shock and surprise, or by eliminating a key capability of the force.

[14] Joint Chiefs of Staff, Joint Doctrine for Intelligence Support to Operations, III-3 to 6.

[15] Alberts, 53-85. Reimer, 41-43. Robert H. Scales, "A Sword with Two Edges: Maneuver in the 21st Century Warfare," Strategic Review, Spring 1999, 45-50.

[16] Hayden, 28.

[17] The geo-strategic shifts are: Post Pearl Harbor reorientation to centralized production as evidenced by organizations such as JICPOA; Post World War II and the emergence of the Bi-Polar world viewed both from a deterrence perspective and containment; Collapse of the Soviet Union and emergence of a Uni-Polar world; Rise of transnational threats (terrorism, narcotics, refugees, WMD, etc.) . The major technological advances are: SIGINT; Satellites; IMINT as practiced today; Computers; and Communications (complexity, availability, and throughput). Key sources reviewed for this analysis are: James R. Clapper, Jr., "Defense Intelligence Reorganization and Challenges," Defense Intelligence Journal, Vol. 1, No. 1, Spring 1992, 3-16. A Denis Clift, "In His Own Time a Man is Always Very Modern," Defense Intelligence Journal, Vol. 4, No. 2, Fall 1995, 107-121.

[18] Handel, Leaders and Intelligence, 194-256.

[19] Commission on the Roles and Capabilities of the United States Intelligence Community, Preparing for the 21st Century: An Appraisal of U.S. Intelligence (Washington: 1996). Handel, War, Strategy and Intelligence, 256-270.

[20] Wilson, 7-10. Hayden, 19-20.

[21] Hayden, 19 & 28.

[22] David M. Keithly, "Leading Intelligence In the 21st Century: Past as Prologue?," Defense Intelligence Journal, Vol. 7, No. 1, Spring 1998, 81.

[23] Ibid., 18-19. Wilson, 7-10.

[24] Clift, 111 & 113-114.

[25] Cebrowski, 33. Wilson, 7.

[26] Robert K. Ackerman, "Intelligence Architecture Augments Area Expertise with Data Access," SIGNAL, January 2000, 35.

[27] Walter E. Boomer, "Special Trust and Confidence Among the Trail-Breakers," U.S. Naval Institute Proceedings, vol. 117, no. 11/1,065, November 1991, 50. Hayden, 27-29.

[28] Chairman of the Joint Chiefs, 17.

[29] Department of the Air Force, Global Engagement: A Vision for the 21st Century Air Force, (Washington, D.C.), 2.

[30] Michael V. Hayden, "Warfighters and Intelligence: One Team – One Fight," Defense Intelligence Journal, Vol. 4, No. 2, Fall 1995, 17-18.

[31] Clapper, 7-11.

[32] Liota, 52-53.

[33] Ibid., 53.

[34] Joint Chiefs of Staff, Joint Operations Planning (Joint Pub 5-0) (Washington, D.C.: April 13, 1995).

[35] Ackerman, 4-5.

[36] Jessie Scanlon, "The Thing Network," Wired, February 2000, 76. In addition to the small mention in Wired, the Presto Technologies web site provides more information at www.pretotech.com.

[37] James C. King, "Delivering On-Time Information Superiority," Defense Intelligence Journal, vol. 8, no. 1, Summer 1999, 21.

[38] Handel, War, Strategy and Intelligence, 239-244. Keithley, 80-82.

[39] M. T. Hopgood, Jr., "Experience: Handle With Care," U.S. Naval Institute Proceedings, vol. 117, no. 10/1,064, October 1991, 82.

[40] Clapper, 3-16 and 15-16.

[41] Wilson, 7-10.

[42] Handel, War, Strategy and Intelligence, 234.

[43] Fred V. Reed, "Marines Seek New Solutions to Secure the Urban Arena," Signal, June 1999, 100-102. Mark A. Johnstone, Stephen A. Ferrando and Robert W. Critchlow, "Joint Experimentation: A Necessity of the Future War," Joint Force Quarterly, No. 20, Autumn/Winter 1998-99, 16-19.

Bibliography

Ackerman, Robert K. "Air Intelligence Confronts New Geopolitical Realities." Signal, October 1998, 27-29.

Ackerman, Robert K. " Information Age Poses New Challenges to Intelligence." Signal, October 1998, 23-25.

Ackerman, Robert K. " Intelligence Architecture Augments Area Expertise With Data Access." Signal, January 2000, 34-37.

Ackerman, Robert K. " Kosovo Maps the Future of Information Technologies." Signal, December 1999, 49-53.

Alberts, David S., John J. Gartska, and Frederick P. Stein. Network Centric Warfare: Developing and Leveraging Information Superiority. 2nd ed. Vienna, VA: CCRP Publications, 1999.

Boomer, Walter E. "Special Trust and Confidence Among the Trail-Breakers." U.S. Naval Institute Proceedings, vol. 117, no. 11/1,065, 47-50.

Boren, David L. "Rethinking U.S. Intelligence." Defense Intelligence Journal, vol. 1, no.1, Spring 1992, 17-29.

Campen, Alan D. "Information Age Warfare Must Enlist Civilian Partnerships." Signal, June 1999, 65-70.

Campen, Alan D. "Rush to Information-Based Warfare Gambles with National Security." Signal, July 1995, 67-69.

Campen, Alan D., ed. The First Information War: The story of Communications, Computers, and Intelligence Systems in the Persian Gulf War. Fairfax, VA: AFCEA International Press, 1992.

Cebrowski, Arthur K. and John J. Gartska. "Network-Centric Warfare Its Origin and Future." U.S. Naval Institute Proceedings, vol. 124, no. 1/1,139, January 1998, 28-35.

Chairman of the Joint Chiefs of Staff. Joint Vision 2010. Washington, D.C., 1996.

Clapper, James R. "Defense Intelligence Reorganization and Challenges." Defense Intelligence Journal, vol. 1, no. 1, Spring 1992, 3-16.

Clift, A. Denis. "In His Own Time a Man is Always Very Modern." Defense Intelligence Journal, vol. 4, no. 2, Fall 1995, 107-121.

"Combat Surveillance Method Rolls Out Onto City Streets." Signal, June 1999, 93-96.

Council on Foreign Relations. Report of an Independent Task Force. Making Intelligence Smarter: The Future of U.S. Intelligence. 1997. <http://www.fas.org/irp/cfr.html> (10 January 2000).

Elliot, Ronald D. "Agile Intelligence Enterprise Offers Requisite Flexibility." Signal, October 1998, 79-81.

Franklin, Jude E., Bruce B. Biggs, and Darrell L. Ramsey. "Fourth Wave Advanced Technologies Affect Electronic Intelligence, Warfare." Signal, June 1999, 87-92.

Franks, Frederick, M. Jr., "Full-Dimensional Operations: A Doctrine for an Era of Change." Military Review, December 1993, 5-10.

Fogleman, Ronald R., "Advantage USA: Air Power and Asymmetric Force Strategy." Air Power History, Vol. 43, No.2, Summer 1996, 5-13.

Gingrich, Gerry. "The Agile Mind of Intelligence." Defense Intelligence Journal, vol. 7, no. 1, Spring 1998, 67-77.

Glass, Robert D. and Phillip B. Davidson. Intelligence is for Commanders. Harrisburg, PA: Military Service Publishing Co., 1948.

Gourley, Robert D. "Intuitive Intelligence." Defense Intelligence Journal, vol. 6, no. 2, Fall 1997, 61-75.

Handel, Michael I., ed. Leaders and Intelligence. London, England: Frank Cass & Co. Ltd, 1989.

Handel, Michael I. War, Strategy and Intelligence. London, England: Frank Cass & Co. Ltd, 1989.

Hayden, Michael V. "Warfighters and Intelligence: One Team - One Fight." Defense Intelligence Journal, vol. 4, no. 2, Fall 1995, 17-30.

Hopgood, M.T. "Experience: Handle With Care." U.S. Naval Institute Proceedings, vol. 117, no. 10/1,1064, October 1991, 81-82.

Johnstone, Mark A., Stephen A Ferrando and Robert W. Critchlow. "Joint Experimentation: A Necessity for Future War." Joint Force Quarterly, no. 20, Autumn/Winter 1998-99, 15-24.

Keithley, David M. "Leading Intelligence in the 21st Century: Past as Prologue?." Defense

Intelligence Journal, vol. 7, no. 1, Spring 1998, 78-88.

Kimery, Anthony. "China Syndrome." Military Information Technology, vol. 3, issue 3, 16-18.

King, James C. "Delivering On-Time Information Superiority." Defense Intelligence Journal, vol. 8, no. 1, Summer 1999, 14-23.

Liota, P. H. "Strategy and the Curse of Intended Outcomes." Strategic Review, Winter 2000, 47-54.

Reed, Fred V. "Marines Seek New Solutions to Secure the Urban Arena." Signal, June 1999, 99-102.

Reimer, Dennis J. "The Army After Next: Revolutionary Transformation." Strategic Review, Spring 1999, 41-44.

Robinson, Clarence A., Jr. "Intelligence Agency Adjusts as Mission Impossible Unfolds." Signal, October 1998, 17-19.

Robinson, Clarence A. "Sensor Fusion Exploitation Braces War Fighting Forces." Signal, November 1994, 53-55.

Scales, Robert H. "A Sword with Two Edges: Maneuver in 21st Century Warfare." Strategic Review, Spring 1999, 45-55.

Scanlon, Jessie. "The Thing Network." Wired, February 2000, 76.

Swenson, Russel G. "The Elements of Intelligence Readiness." Defense Intelligence Journal, vol. 3, no. 1, Spring 1994, 53-74.

U.S. Air Force Department. Global Engagement: A Vision for the 21st Century Air Force. Washington, D.C.,

U.S. Joint Chiefs of Staff. Doctrine for Planning Joint Operations (Joint Pub 5-0) Washington D.C.: April 13, 1995.

U.S. Joint Chiefs of Staff. Joint Doctrine for Intelligence Support to Operations (Joint Pub 2-0) Washington D.C.: May 5, 1995.

U.S. Navy Department. Forward . . . From the Sea, Washington, D.C., March 1994.

U.S. Navy Department. Forward . . . From the Sea: The Navy Operational Concept, Washington, D.C., March 1997.

U.S. Navy Department. . . . From the Sea, Washington, D.C., September 1992.

Wilson, Thomas R. "Defense Intelligence Community Challenges for the 21st Century." Defense Intelligence Journal, vol. 8, no. 2, 1999, 7-10.

Wood, C. Norman. "Intelligence Increasingly Relies on Symbiotic Relationship." Signal, October 1998, 14.

Wood, C. Norman. "Let Technology Aid, Not Drive, Military Operations." Signal, December 1999, 14.